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(54) Title of the Invention: Method for forming a polarizing film

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(72) Inventor: Hayashi Y. c/o Alps Electric Co. Ltd, 1-7 Yukitani Otsuka-cho, Ota-ku, Tokyo-to

(72) Inventor: Yamanashi B. c/o Alps Electric Co. Ltd, 1-7 Yukitani Otsuka-cho, Ota-ku, Tokyo-to

(71) Applicant: ALPS ELECTRIC CO. LTD. 1-7 Yukitani Otsuka-cho, Ota-ku, Tokyo-to

(74) Agent: Patent Attorney, Takeshi K.

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Specification

1. Title of the invention

Method for forming a polarizing film

2. Scope of patent claims

Method for forming a polarizing film, characterized in that, after a layer of photosensitive resin has been applied to a substrate, numerous fine grooves are formed in the surface of this layer of photosensitive resin by performing interference exposure and development processes using holographic techniques, and iodine or a dichromatic dye as the polarizing element is oriented and dyed in these fine grooves.

3. Detailed description of the invention

[Industrial field of application]

The present invention relates to a method for forming a polarizing film having a polarizing function, and more particularly to a method for forming a polarizing film which is applied to liquid crystal display components (referred to below as LCDs).

[Prior art]

In LCDs according to the prior art, as shown in Figure 6, a pair of polarizing plates 7, 8 is mounted on the outer surfaces of upper and lower glass substrates 1, 2, in other words on the faces opposed to the faces on which transparents electrodes 3, 4 and orientation films 5, 6 are formed. These polarizing plates 7, 8 are connected to the two glass substrates 1, 2 by means of a sealing substance 9, and furthermore after the liquid crystal cell has been completed by enclosing the liquid crystal 10, the polarizing plates 7, 8 are stuck to

both the front and rear faces of this liquid crystal cell.

In such polarizing plates for LCDs, the polarizing film, also referred to as H film, dyed using iodine or a dichromatic dye as the polarizing element with stretching of the polarizing substrate composed of a polyvinyl alcohol or the like, is formed in grooves sandwiched between a pair of protective films composed of cellulose acetate or the like, and is stuck to the LCD substrate by means of an adhesive applied to the outer surface of one of these protective films.

[Problem to be solved by the invention]

However, with the abovementioned polarizing plate according to the prior art, there is the problem that, as foreign matter such as waste material or the like and air is occluded at the time of sticking to the substrate, there is the risk of the quality of the LCD display being degraded and the yield being reduced.

Therefore, the object of the present invention is to provide a method for forming polarizing films for LCDs with which it is not necessary to stick on a separate polarizing plate.

[Means of solving the problem]

The abovementioned object of the present invention is achieved in that after a layer of photosensitive resin has been applied to a substrate, numerous fine grooves are formed in the surface of this layer of photosensitive resin by performing interference exposure and development processes using holographic techniques, and iodine or a dichromatic dye as the polarizing element is oriented and dyed in these fine grooves.

[Action]

With the abovementioned means, the photosensitive resin layer in which the photosensitive elements are oriented and dyed functions as a polarizing element, so that it is possible to omit the process in which a separate polarizing plate is stuck to the substrate, and there is no risk of foreign matter or air being occluded.

[Exemplary embodiments]

Exemplary embodiments of the present invention will be described below on the basis of the figures.

Figure 1 is a sectional view of the LCD showing a polarizing film according to the first embodiment of the present invention, Figure 2 is a magnified view of the main parts thereof, and the same symbols have been used for corresponding parts in Figure 6.

In the LCD shown in Figures 1 and 2, a layer 11 of photosensitive resin composed of photosensitive polyimide and a photosensitive polyvinyl alcohol is coated onto one face of upper and lower glass substrates 1, 2 which have transparent electrodes 3, 4 and orienting films 5, 6 formed in advance on their other face, iodine 12 as a polarizing element is oriented and dyed in numerous fine grooves 11a on the surface of the layers 11 of photosensitive resin, in addition a protective coating 13 composed of an acrylic resin or the like is applied to the surface of the layers 11 of photosensitive resin and the surface of this protective coating 13 is flattened. Therefore, the layer 11 of photosensitive resin in which iodine 12 has been oriented and dyed functions as a polarizing film and by protecting said layer with protective coating 13 a flat structure with minute irregularities is formed.

This polarizing film can be formed by means of holographic techniques using an optical system such as that shown in Figure 3. In other words, this optical system is configured such that laser light from a light source 14 which generates Ar laser and He-Ne laser is irradiated towards a beam splitter 16 via a collimator unit 15, and light which is reflected at the mirror 17 and light which is reflected at the mirror 18 form interference marks on the surface of the layer 11 of photosensitive resin, and because the interference marks of the laser light which has been split off at the beam splitter 16 are exposed on the surface of the layer 11 of photosensitive resin which is a hologram surface, numerous fine grooves 11a which extend in parallel with one another and which correspond to the interference marks are formed, as shown in Figure 4, when these interference marks are photographically developed and cleaned. Then, after this, as dyeing iodine 12 in the surface of the layer 11 of photosensitive resin using iodine solution results in a state in which iodine 12 is oriented along the fine grooves 11a, a polarization film is formed directly on the glass substrate 1.

It is to be noted that if the wavelength of the laser light is made $\lambda$ and the polarization angle with respect to the glass substrate 1 of the mirror 18 is made $\theta$, the pitch of the fine grooves 11a can be made $\lambda/\sin\theta$. In addition, instead of iodine as the polarizing element, a dichromatic dye may also be used.

If a polarizing film is formed directly onto glass substrate 1 or 2 in this way, a protective coating 13 is applied in order to form a flat surface with minute irregularities, while protecting this polarizing film, and immediately after this an LCD as shown in Figure 1 is obtained by assembling the cell using these glass substrates 1, 2 and enclosing the liquid crystal 10.

In this way, as the polarizing film is formed directly on the glass substrate in the abovementioned embodiment, there is no need to stick on a separate polarizing plate, and therefore the occlusion of foreign matter and air which can easily occur during the sticking operation does not occur, and it is possible to improve the manufacturing yield of LCDs to a remarkable degree.

Figure 5 is a sectional view of an LCD showing a polarizing film according to another embodiment of the present invention, the same symbols have been used for components corresponding to those in Figure 1.

The LCD shown in Figure 5 is an example of a case in which the polarizing film is provided on the opposite face of the upper and lower glass substrates 1, 2. In other words, in this exemplary embodiment, after numerous fine grooves have been formed in the surface of the layer 11 of photosensitive resin which has been applied to the glass substrate 1 or 2 using holographic techniques in the same way as in the abovementioned exemplary embodiment, a dichromatic dye as the polarizing element is made in the polarizing film by orienting it and dyeing it in these fine grooves, and in addition a protective coating 13, transparent electrode 3 or 4 and an orienting film 5 or 6 are successively formed on this polarizing film and immediately afterwards a cell is assembled using these glass substrates 1, 2. Therefore, it is not only possible to omit the process in which a separate polarizing plate is stuck on, but also there is no need to form a separate undercoat layer because it can be anticipated that, in contrast to the need, in conventional LCDs, to provide an undercoat layer on the face of the glass substrate where the transparent electrodes are formed in order to prevent the Na constituent coming out of solution from the liquid crystal, the protective coating 13 will perform the

function of an undercoat layer in this exemplary embodiment.

It is to be noted that in this exemplary embodiment, it is not desirable to use iodine which becomes soft under the application of heat as the polarizing element due to the relationships when the transparent electrodes and orienting film are fired after the formation of the polarizing film.

In addition, in the abovementioned exemplary embodiment, although the polarizing film is formed directly onto the glass substrate, the polarizing film can also be formed after the transparent electrodes have been patterned.

Furthermore, the abovementioned exemplary embodiments have been described with respect to a method for forming a polarizing film on an LCD using a glass substrate, but a polarizing film can also be formed by means of the same holographic techniques on an LCD which uses a film substrate.

[Effects of the invention]

As described above, as a layer of photographic resin in which iodine or a dichromatic dye is oriented and dyed using holographic techniques functions as the polarizing film in the present invention, it is possible to omit a process in which a separate polarizing plate is stuck to the substrate and there is no risk of foreign matter or air being occluded so that consequently the quality of the display of the LCD is not degraded and it is possible to provide a method for forming polarizing film for a LCD which makes a large contribution to improving the yield.

## 4. Brief description of figures

Figures 1 to 4 show a first exemplary embodiment of the present invention, Figure 1 being a sectional view of an LCD showing polarizing film, Figure 2 being a magnified view of the main parts of the latter, Figure 3 being a typical figure of an optical system in which the surface of the layer of photosensitive resin film is made the hologram face, and Figure 4 being an explanatory diagram showing the fine grooves formed using this optical system, while Figure 5 is a sectional view of an LCD showing polarizing film according to another embodiment of the present invention, and Figure 6 is a sectional view of an LCD showing polarizing film according to the prior art.

1, 2 - substrate,
11 - layer of photosensitive resin film,
11a - fine groove,
12 - iodine (polarizing element),
13 - protective coating.

Figure 1

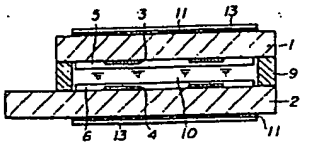
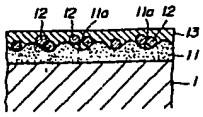



Figure 2




1,2 Substrate
11 Photosensitive resin film
11a Fine groove
12 Iodine (polarizing element)
13 Protective coating

Figure 3

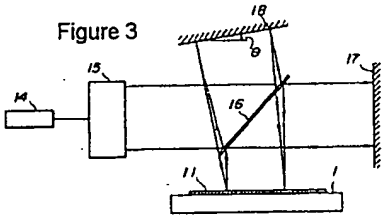



Figure 4

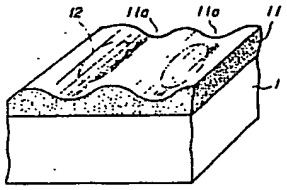



Figure 5

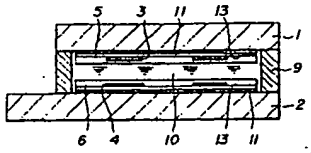
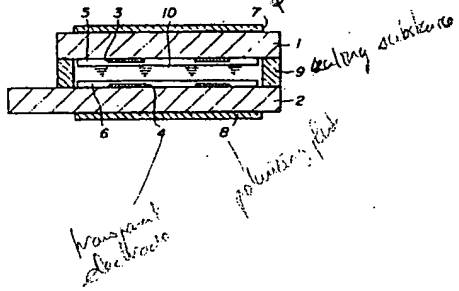



Figure 6



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